

DSN Research and Technology Support

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The major current activities of the Development Support Group at both the Venus Deep Space Station and the Microwave Test Facility are presented, and accomplishments and progress are described. Activities include: pulsar observations, planetary radar with very high resolution range measurement of the planet Mars, tri-cone support structure assembly, 100-kW clock synchronization implementation, precision antenna gain measurement on the 26-m antenna, Block IV receiver/exciter installation and testing, weak source observations of 13 sources, and observations of the planet Jupiter.

The Development Support Group of the RF Systems Development Section is currently engaged in the following activities at the Venus Deep Space Station and the Microwave Test Facility (MTF) at GDSCC:

I. DSS 13 Activities

A. In Support of Section 331

1. *Pulsars.* The twenty pulsars tabulated in Ref. 1 continue to be regularly observed (24 h per week are used for this activity) and data on pulse-to-pulse spacing, power density spectra, and pulse arrival time continue to be collected.

2. *Planetary radar.* This program continues to track the planet Mars. Range measurements with an rms resolution of a few microseconds are being made as a total of twenty-three passes were observed during the period August 16 to October 15, 1971. The Venus ranging program also continued, but only nine Venus passes were observed during this same period.

B. In Support of Section 332

1. *Tri-cone support structure (TCSS).* The first TCSS arrived at DSS 13, was assembled, and cable trays, heating, air conditioning, waveguide, waveguide switches, and receiver mounts have been installed therein. A multi-level platform serviced by an elevator has been erected to make work easier and faster to complete.

2. *Nine-meter antenna alignment.* The deviation of the 9-m antenna main reflector from the best-fit paraboloid was measured and antenna position readouts were aligned by performing tracking of the planet Mars with an "on-axis" mounted theodolite and reference to a precision elevation bubble level with a resolution of 10 arc-sec.

C. In Support of Section 333

1. *Precision antenna gain measurement (26 m).* This program continues with data being gathered by observing the radio star Cygnus A and the *Apollo* lunar surface experiments package (ALSEP) left on the Moon by

Apollo 12. Data continue to be collected by Development Support Group personnel with assistance from Paul Batelaan of Section 333.

2. Weak source observation. Data collection utilizing the noise adding radiometer and an improved antenna pointing computer program (developed by Dr. Michael Klein) continue. Radio sources observed during this period were 3C17, 3C161, 3C218, 3C270, 3C340, 3C348, 3C353, 3C444, CTA21, CTA102, NGC247, NGC772, NGC1275, and the planet Jupiter. Additionally, substantial amounts of time have been devoted to calibration and "sky survey" measurements with the antenna positioned pointing either at Polaris or at an azimuth of 180 deg and elevation of 87 deg. This program is heavily supported by both Section 333 and 825 personnel who participate actively in most of the observations performed.

D. In Support of Section 335

1. 100-kW Clock synchronization transmitting system. Except for minor cleanup and modification action, the installation onto the antenna has been completed and test transmissions have been made to all deep space stations which are equipped to receive. Time correlation has already been achieved by DSSs 14, 41, 42, 51, and 62. However, there are still some unsolved problems with the computer control program, some hardware problems with the exciter/programmed oscillator, and some antenna-pointing anomalies which are not yet completely understood. Some trouble has been experienced with the waveguide switch, but the transmitter has proved to be quite stable and trouble-free at the 100-kW power level.

Very early in the testing period an RF survey was conducted which included not only ground measurements but measurements on the edge of the antenna dish and the back-up structure as well. Hazardous areas (areas with a

measured power in excess of 1 mW/cm²) were observed and a strict program of limited entry is being observed as well as banning radiation out the horn while the antenna is below 10 deg in elevation.

2. Block IV receiver/exciter. After installation and extensive testing, phase-lock tracking of spacecraft *Pioneers 6* and 8 was accomplished. Development of the computer program to allow control of the system by the station SDS 910 computer continues along with regular spacecraft tracking.

II. Microwave Test Facility

A. In Support of Section 332

1. Tri-cone support structure (TCSS). Extensive machine shop and electromechanical support has been afforded the TCSS during this period.

B. In Support of Section 333

1. DSS 14 noise bursts. In support of the continuing investigation into the noise burst problem at DSS 14, a section of WR-430 waveguide, 208.3 cm (82 in.) long with water cooling attached, was fabricated for installation in place of a suspect piece.

C. In Support of Section 335

1. 100-kW Clock synchronization transmitter. Heavy support was given this project during this period with the machine shop fabricating HV connector parts, various brackets, mounts, etc. An RF survey at 7149.9 MHz was also conducted and dangerous areas were delineated. A 10X multiplier was fabricated and the 10-W buffer amplifier, along with an almost complete spare unit, was completed and tested.

Reference

1. Jackson, E. B., "DSN Research and Technology Support," in *The Deep Space Network Progress Report*, Technical Report 32-1526, Vol. III, p. 158. Jet Propulsion Laboratory, Pasadena, Calif., June 15, 1971.